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AUTHOR Jacobowitz, Tina
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ABSTRACT

Science career preferences of junior high students, while not stable predictors of ultimate career choice, do serve to direct and maintain individuals along the paths to careers in science. In this study, factors relevant to science career preferences of black eighth grade students were investigated. This issue is of particular import to blacks since they are severely underrepresented in the scientific fields. The sample consisted of 113 males and 148 females in an inner city junior high school. The Science Career Preference Scale, the Peabody Picture Vocabulary Test, and the Self-Concept of Ability Scale (Form B--Science) were administered. Mathematics and science grades were obtained from class rating sheets. Treatment of the data involved multiple regression analysis according to a hierarchical model. Independent variables rated included the relationships of sex, mathematics achievement, science achievement, science self-concept, and science career preferences. The effects of verbal ability were partialled out of all the variables. Results showed that of all the independent variables, sex was the strongest predictor of science career preferences (males much more often selected science careers), accounting for 25 percent of the criterion variance. The findings suggest that early adolescent science career preferences are related more to interests which are consonant with sex-role considerations than to realistic assessment of mathematics or science achievement. (Author/KC)

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FACTORS ASSOCIATED WITH SCIENCE CAREER PREFERENCES OF BLACK JUNIOR HIGH SCHOOL STUDENTS

TINA JACOBOWITZ

Montclair State College

Department of Educational Leadership

U.S. DEPARTMENT OF EDUCATION
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Running Head: Science Career Preferences of Black Students

Abstract

Science career preferences of junior high-aged students, while not stable predictors of ultimate career choice, do serve to direct and maintain individuals along the paths to careers in science. In this study, factors relevant to science career preferences of Black eighth grade students were investigated. This issue is of particular import to Blacks since they are severely underrepresented in the scientific fields. The sample consisted of 113 males and 148 females in an inner city junior high school. The Science Career Preference Scale, the Peabody Picture Vocabulary Test, and the Self-Concept of Ability Scale (Form B-Science) were administered. Mathematics and science grades were obtained from class rating sheets. Treatment of the data involved multiple regression analysis according to a hierarchical model. Results showed that of all the independent variables, sex was the strongest predictor of science career preferences, accounting for 25 percent of the criterion variance. The findings suggest that early adolescent science career preferences are related more to interests which are consonant with sex-role considerations than to realistic assessment of mathematics or science achievement.

The number of Blacks who pursue careers in science remains surprisingly low despite the removal of many social barriers to their full participation in society (Dillon & James, 1977). Although numerous attempts have been made to improve minority representation in science, they have been unsuccessful in meeting manpower parity goals (Rowe, 1977). Modification of this trend is contingent upon an increased understanding of the career development of Blacks. Without such understanding of the processes of the career evolution of Blacks, well intended interventions designed to improve the situation may continue to be ineffective, inappropriate and based primarily on intuition.

Although considerable information exists on the development of careers in science, much of this evidence is nearly two decades old. Most of these studies are restricted to grades eleven and higher, focusing on individuals already interested in science (Malcolm, Cownie & Brown, 1976). In addition, most investigations have concentrated on White American males (Cooley, 1963; Roe, 1961; Terman, 1954) and thus have limited generalizability to minority populations (Smith, 1975). It is important therefore, to examine the generalizability of research findings in the area of vocational preferences to Black individuals.

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In an extensive reanalysis of the Project Talent data, collected from 400,000 participants representing approximately 5% of the high schools in the United States in 1960 (Flanagan, Daily, Shaycoft, Gorham, Orr & Goldberg, 1962), it was found that the variable most closely related to entering a science career was the expression of a science career preference in high school (Gilmartin, McLaughlin, Wise & Rossi, 1976). Research on science career development indicates that such preferences for science careers begin even earlier than high school (Strauss & Rainwater, 1962). As these preferences may serve to direct and maintain early adolescents along the science career path, it is important to examine career preferences of Blacks during the junior high school years, ones which appear formative in the development of future scientists.

One of the most critical decisions the potential scientist makes along the path to a science career is the choice of science and mathematics courses in high school. Such a decision may be strongly influenced by career preferences established in junior high school or even earlier. Researchers have demonstrated that the number of science and mathematics courses taken in high school is positively related to science career plans (Dillon & James, 1977; Gilmartin et al., 1976).

In Gilmartin's sample of eleventh grade students, Whites had taken the most courses in science and mathematics, while Blacks had taken the fewest. This finding may relate to the scarcity of Blacks in scientific careers and underscores the importance of investigating factors associated with career preferences of Blacks.

Research indicates that sex is an important variable related to individuals' preferences for science careers (Gardner, 1975; Rever, 1973). The dearth of women in most scientific fields may be a result of their perception of science and engineering as male pursuits (Plotkin, 1976). Patterns of enrollment in high school and college courses seem to confirm the belief that science careers are male oriented. Although some researchers assert that women are entering science programs in greater numbers than ever before (Gilmartin, et al., 1976; Parrish, 1975), women still remain under-represented, under-promoted, and under-paid in science fields relative to men (Vetter, 1976).

There is a large body of literature which attempts to explain why girls exhibit less interest in science from a very early age and why this lack of interest persists throughout the educational years and into adulthood (Gardner, 1975; Rever, 1973). Explanations for this phenomenon focus on biological differences in aptitudes

necessary to science achievement (Gardner, 1975), person-thing orientation (Gilmartin et al., 1976), early socialization and sex-role learning (Barnett, 1975; Baumrind, 1972; Harway & Astin, 1977), and ultimately, sex-discrimination (Gilmartin et al., 1976).

The limited amount of literature related to sex differences in occupational preferences of Blacks indicates that differences exist between males and females (Burlew, 1977; Sprey, 1962). Data reported by Harway and Astin (1977) indicate that the proportion of Black women in the highest paying professions is very low relative to Black men. Black men outnumber Black women in medical and engineering professions, while Black women predominate in more traditionally feminine occupations, such as elementary school teaching and social work. Thus, sex appears to be a strong determinant of science career preferences. While current research supports the notion that the orientation of female adolescents toward science may be changing, employment statistics do not reflect this change.

Much of the research on career preferences of junior high school children has focused on mathematics and science achievement as predictors of vocational preferences. Unfortunately, most of the samples employed in these studies consisted of White males (Cooley, 1963; Krippner, 1963).

In addition, findings of such studies are equivocal and suggest that mathematics and science achievement are not sufficient predictors of the career preference of this particular age group. Results of several investigations with older populations, however, (Astin, 1967; Cooley, 1963; Gilmartin et al., 1976) do indicate that success in science and mathematics helps direct both Black and White high school students toward science careers. According to Gilmartin et al. (1976), the factors that lead to under-representation of Blacks in science are mediated largely by differences in levels of developed abilities and achievement needed in science careers. Such abilities, which consist primarily of mathematics and science skills and knowledge, are developed before and during high school and are strong predictors of science career preferences in high school and college (Cooley, 1963; Gilmartin et al., 1976). However, because this research used older populations, the findings are not generalizeable to Black junior high school students. Thus, it is important to examine factors additional to science and mathematics achievement which may be related to the career interests of eighth grade students.

Several researchers have found that self-concept variables are related to the vocational preferences of high school and college subjects (Bedeian, 1977;

Blocher & Schutz, 1961; Dillon & James, 1977; Harway & Astin, 1977; Super, 1957; Super, Starishersky, Matlin & Jordaan, 1963). There is some evidence that self-estimates of ability, whether accurate or not, are effective determinants of career plans (O'Hara, 1967). Little research, however, has been conducted which relates self-concept of ability to the career preferences of junior high school students.

The notion that individuals' self-concepts can influence their behavior is based primarily on the phenomenological theory of Combs and Snygg (1949) and the symbolic interaction theory of G. H. Mead (1934). In this framework, the self is viewed as essentially a social product arising out of interactions with others. For example, what children are able to learn is functionally limited by their perceptions of views that significant others (e.g., parents, teachers, peers) hold of them as learners. According to Maehr (1969), children's reactions to experiences are based more on views that significant people hold of them than upon the actual success or failure of experiences.

Research indicates that vocational development is essentially a process of developing and implementing one's self-concept (Super et al., 1963). During early adolescence, students draw upon their experiences in

the home and in school to clarify their self-perceptions, to increase their information about occupations, and to synthesize their conceptions of self and work in the expressions of tentative vocational choices (Super, 1957). Accordingly, self-concept influences vocational preferences. When expressing vocational preferences, individuals put into occupational terminology the idea of the kind of people they are (Super, Crites, Hummel, Moser, Overstreet & Warnath, 1957). The expression of tentative science career preferences by junior high school aged students in turn may influence educational decisions relevant to ultimate careers in science.

Previous studies of self-concept, particularly those involving Blacks, have tended to emphasize global rather than specific aspects of the construct, even when predicting situation-specific behaviors (Miller & Woock, 1970). Little attention has been devoted to the relation of situation- and subject-specific aspects of self-concept and vocational variables within the Black population. Such research appears valuable particularly in light of Mischel's (1968) observation that global personality traits rarely explain more than ten percent of the variance in human behavior. In addition, Caplin (1968) purports that academic self-concept is a more useful construct than global self-concept in research with Black children.

Within the present study, the self-concept is viewed as a multifaceted construct consisting of situation- and subject-specific factors that are hierarchical in nature (Shavelson, Hubner, & Stanton, 1976). The global self-concept is divided into two major categories; academic self-concept and non-academic self-concept. Subject-specific self-concepts (including mathematics, science, English and history) are subsumed under academic self-concept. Self-concept depends increasingly on specific situations and becomes less stable as one descends the self-concept hierarchy (Sharelson, et al., 1976). To effect any changes in specific behaviors, an intervention must influence the particular self-concept that is relevant to that specific behavior. It was reasoned therefore, that science self-concept would be a better predictor of science career preferences than measures of global or academic self-concept.

In sum, the present study was designed to gain further understanding of factors that may be related to the scarcity of Blacks in science occupations. The relationships of sex, mathematics achievement, science achievement, and science self-concept to science career preferences were explored using multiple regression analyses. The method for investigation was conceptualized within the self-concept model posited by Shavelson et al.,

(1976) and the vocational development theory developed by Super (1957).

Method

Participants

The participants of this study were 261 eighth grade Black students attending an inner city junior high school in a large Eastern metropolitan area. Because this particular school employs a tracking system in which students were assigned to one of five achievement levels (tracks), a stratified random sampling procedure was used to ensure that a representative sample of students was selected from each track. The number of classes randomly selected from each track was determined relative to the proportion of students in each track in the entire eighth grade, as well as by projected attrition rates due to absenteeism in the lowest track. The final sample consisted of 148 females and 113 males from fourteen classes, who ranged in age from 12 to 14 years.

Instruments

The Science Subscale of the Self-Concept of Ability Scale. The science subscale of the Self-Concept of Ability Scale, Form B (Brookover, Paterson, & Thomas, 1962) consists of eight self-evaluative items which

deal with science ability. The items are arranged in a Likert format constructed to measure both future- and present-oriented comparative evaluations of one's achievement in science. Internal consistency reliabilities for the science subscale were .94 for males and .93 for females in a tenth grade sample (Brookover, LePere, Hamachek, Thomas, & Erikson, 1965). Test-retest reliability coefficients, reported for a one-year interval, were .80 for boys and .67 for girls drawn from grade 10 (Brookover et al., 1965). An alpha reliability coefficient of .85 was obtained in the present study.

The Science Career Preference Scale. The Science Career Preference Scale was developed to assess students' orientations toward science careers as indicated by their preferences for particular science careers over particular non-science careers. Five science occupations were selected as representative of science careers: (1) Biochemist; (2) Science Professor; (3) Optometrist; (4) Meteorologist; and (5) Aerospace Engineer. The scale was assessed by six professors and psychologists in science education and counseling psychology who agreed that the domain of science occupations was representatively sampled. In order to provide choices between science-related and non-science related occupations, five jobs, representing major occupational areas other than science

and engineering and of equal prestige to the science occupations were selected from the Occupational Outlook Handbook (1977): (1) Lawyer; (2) Social Worker; (3) City Planner; (4) Librarian; and (5) English Professor. Preferences were assessed by the method of paired-comparisons in which participants selected careers from 45 ordered pairs of occupations. This method was employed because it is a simple and understandable way of assessing preferences and appeared to be most appropriate for this age group. The 10 job titles were randomly assigned numbers and were arranged for the paired comparison task between all occupations (Torgerson, 1958). Two forms of the paired comparison list were used to counterbalance presentation order of titles within comparisons (AB, BA). To control for the effects of repeated exposure to the occupations, paired comparisons were divided into nine blocks of five occupations with each title appearing in one of the five positions within each block an approximately equal number of times. There was a minimum of two paired comparisons between repetitions of each title.

To ensure baseline knowledge of each occupation, subjects were shown 10 slides, each depicting a Black male and a Black female for each occupation. The experimenter read aloud short descriptions of the occupations

which were of equal length and were all on the seventh grade reading level as calculated by the Fry Readability Formula (Fry, 1968). Instructions were presented in both oral and written form to the class and students marked their preferences on answer sheets as the slides were presented.

Students were not informed as to which careers were science-related because of the possible negative bias which might have resulted from this knowledge. Subsequent to the paired-comparison task, therefore, a brief questionnaire was administered to assess students' perceptions of science occupations. Students were asked to check those occupations which they considered to be science jobs. Slides depicting the 10 occupations were shown, and their titles were read aloud by the experimenter as the students checked them off on a list. Those students who perceived less than 7 out of 10 occupations correctly were dropped from the study. This procedure ensured that students' perceptions were accurate with 95% confidence regarding which careers were science-related and which were not.

Paired comparison data were scaled for the total group using Case V of the Law of Comparative Judgment (Torgerson, 1958). The goodness of fit test was conducted by evaluating the absolute value of the discrepancy

between observed paired comparison proportions and paired comparison proportions predicted by the derived model. Over all paired comparisons, the mean discrepancy was .02 which is indicative of an excellent fit of the model. This indicates that students' judgments were highly transitive, suggesting that the Science Career Preference Scale is a unidimensional, interval scale. An alpha reliability coefficient of .78 was obtained in the present study.

Mathematics and Science Achievement. Mathematics and science achievement were measured by using actual grades obtained by students for the third quarter of the academic year. These grades were recorded approximately one week prior to the testing sessions. The grade system utilized in the school selected for this study was uniformly prescribed by the school administration. For a given student, grades in mathematics and science consisted of three components; score on a standardized test, scores on teacher-made tests, and teacher evaluation of student learning characteristics.

The Peabody Picture Vocabulary Test. The Peabody Picture Vocabulary Test was developed by Dunn (1965) as a measure of verbal ability. Since verbal ability is known to be highly correlated with academic performance,

and since the measures of self-concept and career preferences were presented in a verbal format, this index was included in the present study as a covariate. In the present study an alpha reliability coefficient of .95 was obtained.

Procedure

Data were collected during three testing sessions that were one week apart. The Science Career Preference Scale was administered to each class in the first session to avoid possible biasing effects of the other instruments. In the remaining sessions, the Peabody Picture Vocabulary Test and the Science Self-Concept Scale were administered such that one half of the classes responded to the Peabody Picture Vocabulary Test first and the other half to the Science Self-Concept Scale first, to control possible effects of ordering in the total group. The Science Career Preference Scale was administered in approximately 30 minutes; the Peabody Picture Vocabulary Test in 40 minutes; the Science Self-Concept Scale in 10 minutes.

Results

Table 1 contains the means and standard deviations of the five variables, verbal ability, mathematics achievement, science achievement, science self-concept, and

science career preferences, derived for the entire population and also separately for males and females. Significance of sex differences with respect to the five variables, as determined by t-tests, are also indicated in Table 1.

It is important to note that while there were no significant differences in mean scores between the sexes in mathematics and science achievement, there were significant sex differences between the means of science self-concept and science career preferences with the boys' means being higher than the girls' means on both variables.

INSERT TABLE 1 ABOUT HERE

As can be seen in Table 2, the correlation between mathematics and science achievement was significant and moderately high. The correlation of mathematics achievement with science career preferences was not significant, however, while the correlation of science achievement with the criterion variable was significant but low. In addition, there was a low, but significant correlation between science self-concept and science career preferences. Most interesting is the moderately high correlation of sex with science career preferences.

INSERT TABLE 2 ABOUT HERE

A hierarchical regression model was employed to analyze the relationships of sex, mathematics achievement, science achievement, science self-concept and science career preferences after the effects of verbal ability were partialled out of all the variables. The hierarchical technique was utilized as opposed to a free stepwise regression analysis in order to test the added contribution of the self-concept variable beyond that already made by the sex and achievement variables (Winne & Walsh, 1980). In addition, the entry order of the variables was based on theory and research in self-concept and achievement. The results of the regression analyses are presented in Tables 3, 4 and 5. As shown in Table 3, sex accounted for 25 percent of the variance in science career preferences when it was entered into the regression equation first.

INSERT TABLE 3 ABOUT HERE

Table 3 also indicates that when mathematics achievement was added to the equation containing sex, the increment in predictable variance was one percent, which was not significant, F (1,258) = 3.77.

As illustrated in Table 4, when science achievement was entered into the equation after sex, the increment in predictable variance was 3.2 percent which was significant, F (1,250) = 11.56, $p < .01$.

INSERT TABLE 4 ABOUT HERE

As can be seen in Table 5, when science self-concept was entered into the equation after sex, mathematics achievement and science achievement, predictable variance increased significantly by 6 percent, F (1,256) = 23.48, $p < .01$. The linear combination of sex, mathematics and science self-concept accounted for 34 percent of the variance in science career preferences.

INSERT TABLE 5 ABOUT HERE

Supplementary analysis was performed on the data to determine if order of entry of the independent variables

had affected the outcome. The original entry order of the variables had been chosen primarily based on the research literature. Sex was entered first because, of all four variables, it has been demonstrated to be the strongest predictor of career direction (Gilmartin et al., 1976; Kutner & Brogan, 1976; Rever, 1973). The achievement variables were added next because a substantial amount of the existing research has focused on the relationship of mathematics and science achievement to science career preferences. There has been a limited amount of inquiry into the relationship between science self-concept and science career preferences. A major purpose of the present investigation, therefore, was to examine the contribution of science self-concept to the predicted variance in science career preferences independent of mathematics and science achievement. For this reason, science self-concept was entered in the equation after sex and the two achievement variables. In addition, current research in self-concept and achievement indicates that achievement may causally affect self-concept (Calsyn & Kenny, 1977; Scheirer & Kraut, 1979), and should therefore be entered prior to self-concept in the regression equation. This issue of causal direction is, however, still debatable. Therefore, additional analysis was performed on the data to determine

if the achievement variables would contribute differentially when added last in the equation. As can be seen in Table 6, one change did result from a reordering of the variables. When science achievement was entered fourth in the equation instead of second, it no longer accounted for a significant proportion of the criterion variance, $F(1,256) = 1.35$. This phenomenon may be due to the moderate to high proportion of this variance shared by the achievement and self-concept variables.

INSERT TABLE 6 ABOUT HERE

Additional analysis was performed on the data obtained from the Science Career Preference Scale to determine which science occupations were preferred more by each sex. Table 7 indicates the means and standard deviations derived by sex for each occupation.

INSERT TABLE 7 ABOUT HERE

As shown in Table 7, except for the optometrist, the boys' means for each science occupation were significantly higher than those of the girls, which shows that

the boys chose these four occupations more times than the girls did. In addition, the girls' mean for the optometrist was significantly higher than their means for the four other occupations, indicating that they chose this profession more times than the other professions.

In summary, the data indicate that sex is a better predictor of science career preferences than any of the other variables. Mathematics achievement did not account for a significant proportion of criterion variance. While science achievement accounted for a statistically significant proportion of the predicted variance (3 percent), it may be considered very low. Science self-concept also accounted for a small amount of variance in science career preferences (6 percent). It is important to note that science self-concept was entered into the equation after sex, mathematics and science achievement, and thus shared no variance with science career preferences which overlapped with these other independent variables. Thus, the contribution of science self-concept should not be viewed with the same expectation as for squared zero-order correlations of variables entered early in a regression equation. When science achievement was entered into the equation after sex, mathematics achievement, and science self-concept, it no longer accounted

for a significant proportion of the predicted variance in science career preferences.

Discussion

The finding that sex accounted for the major proportion of the variance in science career preference is consistent with Rever's (1973) assertion that sex is the single most powerful influence on direction of science career path. As noted, females in the current sample had science and mathematics achievement scores that were similar to males. These findings lend support to the conclusion that factors other than ability account for the under-representation of women in "hard" science fields (Gilmartin et al., 1976). One possible explanation is that girls do not prefer science careers as much as boys because of early socialization practices which operate through literature, parental expectations, and the expectations of teachers (Gardner, 1975; Harway & Astin, 1977). These social forces have taught girls that science is a masculine field. Preference for a science career over a non-science career may raise a conflict for girls, who are expected to be friendly, cooperative, nurturing and affiliative (Baumrind, 1972; Frieze, Parsons, Johnson, Ruble, & Zellman, 1978; Gardner, 1975). These particular personality characteristics

are in opposition to the stereotypic view held of scientists, who are considered to be intensely masculine and even brutally aggressive (Mitroff, 1976).

From a developmental perspective, adolescence, for girls, may be viewed as a time of transition to feminine goals (Douvan & Adelson, 1966). The junior high school girl, who has internalized the gender standards of the society, may have difficulty integrating her individual goal of pursuing a science career with her desire to appear feminine. According to several psychologists (Block, 1973; Chodorow, 1971; Gutman, 1965), socialization impinges differentially on the two sexes, and results in development of masculine and feminine self-concepts. Within the multidimensional, hierarchical model of self-concept (Shavelson et al., 1976), it is presumed that sex-role self-concept, a component of the global self-concept, is subsumed under non-academic self-concept. Although science self-concept is subsumed under academic self-concept in the model, results of the present investigation indicate the possibility that science self-concept is related to sex-role self-concept.

The notion that preference for a science career may raise a sex-role conflict in girls supports Super's theory that occupational preferences represent a translation

of self-concepts into vocational terms (Super et al., 1963). Super considers individuals' desires to find expression for their self-concepts to be influential in the process of choosing a career. This conflict is not raised for boys of this age, whose strivings for masculinity are highly compatible with the goals of attaining careers in science. This situation is true for Black as well as White females. In a nation-wide study of high school juniors, the job choices of both Black and White females tended to cluster in three areas: clerical, education and social services, nursing and human care (Prediger, Roth & Noeth, 1974). According to Burlew (1977), Black females who attend colleges and universities tend to choose careers in traditionally feminine fields. When Black women in another study were asked about the "person they would most like to be," they chose educators and creative or performing artists, while Black men selected roles as businessmen, athletes and scientists (Harway & Astin, 1977). Although these studies involved older Black women, it appears that the conflict between choosing science as a career goal and the desire to appear feminine is evident in the younger Black females in the current investigation.

That mathematics achievement did not account for a significant proportion of the variance in science

career preferences in the present sample is consistent with Cooley's (1963) finding that the mathematics achievement of White eighth grade boys was not related to their science career preferences stated in the ninth grade. More important, this finding supports theory which suggests that career preferences at this age may be based more on fantasies of what one would like to be, rather than on realistic evaluation of abilities and achievement (Super, 1957). It is, therefore, possible that participants in the present investigation are not yet aware that a career in science presupposes achievement in mathematics and for this reason did not consider their mathematics achievement when indicating preferences for science careers. It is also assumed that students did not realistically assess their science achievement when indicating their career preferences. The low proportion of shared variance with science career preferences is most likely due to the association made by students between science activities in school and the activities of scientists presented in the Science Career Preference Scale. It is likely that an individual who exhibits interest in science will not only do well in science, but will also prefer science occupations over non-science occupations.

Results of the data analysis indicated that science

self-concept accounted for a significant proportion of the criterion variance in addition to sex, mathematics and science achievement. This finding is consistent with Super's assertion that one attempts to select occupations which will be compatible with one's self-concept (Super et al., 1957). In studies by Blocher and Schutz (1961), Englander (1960), and Morrison (1962), the findings showed that students rated their personalities as more similar to a preferred occupation than a non-preferred occupation.

It is important to note again that even though the relationship between science self-concept and science career preferences was positive for both sexes, the boys' mean science self-concept score was significantly higher than that of the girls'. This result is somewhat surprising in that the mean science achievement scores of the two sexes were not significantly different. One possible explanation for this finding comes out of the phenomenological and symbolic interactionist theories of self-concept (Combs & Snygg, 1959; Mead, 1934). Within this framework, self-concept is viewed as one's perception of oneself, formed through experience with one's environment, and influenced especially by environmental reinforcements as well as by significant others. As a result of socialization practices within society,

it appears that boys are reinforced more for scientific achievement and behaviors than are girls and thus have higher science self-concepts than girls, despite their similar achievement. In addition, the prevalence of male over female scientists in this country offers boys the benefit of role models with which to identify, thus making it easier to incorporate science as a possible future career into their self-concepts.

That girls in the present sample chose the optometrist significantly more times than the other science occupations is consonant with Gilmartin's contention that although women appear to have discarded the stereotype that science is a man's world, they continue to some extent to follow the stereotypes of male-female fields within science (Gilmartin et al., 1976). Other theorists have indicated that early adolescent girls, as well as older women, prefer jobs that permit expression of traditionally female themes, such as nurturance and need for affiliation (Douvan & Adelson, 1966; Oetzel, 1966). A recent survey of numbers of women employed in different science areas shows that the greatest percentage of women scientists is in medically-related fields (Plotkin, 1976). The fact that the optometrist was the most favored science occupation of females, and one of the least favored of males in the current sample (see Table 7), lends

credence to the argument that career preferences are based on sex-role considerations. Even though students recognized optometry as a science-related field, both males and females appear to view it as a feminine occupation.

Based on the findings of this study, it is suggested that educational interventions designed to channel more Blacks into science careers should attempt to eliminate students' perceptions of science as a masculine domain. Career counseling at the junior high level should give special attention to non-traditional science careers for women. Black females should be advised to enroll in mathematics and science courses in high school. Efforts should be made to enable Black females to interact with female role models, as well as to be exposed to films and publications on the lives and actions of women scientists. In addition, interventions such as group discussion with Black adolescent males, as well as females, are needed for sex-role restructuring. Attempts should be made by teachers to enhance science self-concept through reinforcement of specific scientific behaviors. Particularly, girls should be encouraged to participate in laboratory experiments; students must be taught that success in science is positive for both males and females and does not detract from the feminine self-image.

Further, an effort must be made to increase Black students' awareness of the link between their school achievement, particularly in mathematics, and science careers. Students should be taught that vocational development is a continual process, and they need to become sensitive to the relationship between their actions and that process (Gilmartin et al, 1976). Awareness of the types of courses which are prerequisite to various science occupations can be developed so that appropriate curriculum choices are made in high school. Students should be sufficiently informed of their academic competencies and provided with adequate occupational information, so that they can begin to make realistic matches between their abilities and occupational preferences. In this way, intelligent educational decisions can be made, with the help of school personnel, which do not preclude Black students from entering scientific careers.

Finally, results of the present study suggest that the relationship between science self-concept and sex-role self-concept of Black students may be stronger than the relationship between science self-concept and science achievement. Further investigation of the relationships among these variables, therefore, is needed in order to increase the probability of success of science self-concept enhancement programs and ultimately to channel more Blacks into science careers.

Table 1

Means and Standard Deviations for Total Population,

Males and Females on Each Variable

	Population (N=261)		Males (N=113)		Females (N=148)		
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	t
Verbal Ability	88.59	15.96	91.33	14.94	86.50	16.44	2.45*
Mathematics Achievement	73.71	12.83	72.64	12.11	74.53	13.33	1.18
Science Achievement	73.16	12.03	73.81	10.88	72.68	12.86	.75
Science Self-Concept	28.27	4.95	29.14	4.69	27.61	5.06	2.50*
Science Career Preferences	11.51	5.92	14.95	5.30	8.89	4.95	9.52**

*$p < .02$

**$p < .001$

Table 2

First-Order Partial Correlations of the Five Variables with Verbal Ability Partialled Out

Variable	1	2	3	4	5
1. Sex	--	-.11*	-.01	.14*	.50***
2. Mathematics Achievement		--	.64***	.31***	-.05
3. Science Achievement			--	.45***	.18**
4. Science Self-Concept				--	.37***
5. Science Career Preferences					--

*p < .05, two-tailed

**p < .01, two-tailed

***p < .001, two-tailed

Table 3

Multiple Regression of Sex and Mathematics Achievement on Science Career Preferences

Source	Multiple R	R^2	df	F-Value
Sex	.50	.25	1,259	85.65*
Sex + Mathematics Achievement	.51	.26	2,258	45.16*
Increment due to addition of Mathematics Achievement		.01	1,258	3.77

*$p < .01$

Table 4

Multiple Regression of Sex and Science Achievement on Science Career Preferences

Source	Multiple R	R^2	df	F-Value
Sex	.50	.25	1,259	85.65*
Sex + Science Achievement	.53	.28	2,258	50.35
Increment due to addition of Science Achievement		.03	1,258	11.56*

*$p < .01$

Table 5

Multiple Regression of Sex, Mathematics Achievement, Science Achievement, and Science Self-Concept on Science Career Preferences

Source	Multiple R	R^2	df	F-Value
Sex	.50	.25	1,259	85.65*
Sex + Mathematics Achievement + Science Achievement	.53	.28	3,257	33.48*
Sex + Mathematics Achievement + Science Achievement + Science Self-Concept	.58	.34	4,256	33.16*
Increment due to addition of Science Self-Concept		.06	1,256	23.48*

*$p < .01$

Table 6

Multiple Regression of Mathematics and Science Achievement on Science Career Preferences When Each Variable is Entered Last in the Regression Equation

Source	Multiple R	R^2	df	F-Value
Sex + Science Achievement + Science Self-Concept	.58	.34	3,257	44.20*
Sex + Science Achievement + Science Self-Concept + Mathematics Achievement	.58	.34	4,256	33.16*
Increment due to the Addition of Mathematics Achievement		.00	1,256	.37
Sex + Mathematics Achievement + Science Self-Concept	.58	.34	3,257	43.71*
Sex + Mathematics Achievement + Science Self-Concept + Science Achievement	.58	.34	4,256	33.16*
Increment due to the Addition of Science Achievement		.00	1,256	1.35

*$p < .01$

Table 7

Means and Standard Deviations for Males and Females for the Five Science Occupations

		Mean	Standard Deviation	df	t-valu
Aerospace Engineer	Males (N=113)	3.55	1.54	259	14.62*
	Females (N=148)	.95	1.25		
Optometrist	Males (N=113)	2.71	1.43	259	.96
	Females (N=148)	2.53	1.50		
Meteorologist	Males (N=113)	3.04	1.39	259	7.23*
	Females (N=148)	1.81	1.31		
Science Professor	Males (N=113)	2.70	1.53	259	4.98*
	Females (N=148)	1.76	1.46		
Biochemist	Males (N=113)	2.96	1.40	259	5.72*
	Females (N=148)	1.89	1.61		

*$p < .001$

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